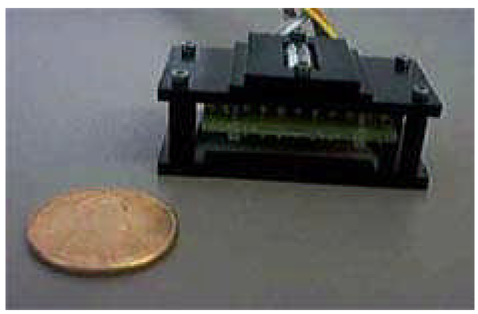
Lightweight Sun-Position Sensor Developed

An orbiting spacecraft needs to be able to accurately locate the position of the Sun so that the solar arrays can be pointed toward the Sun. This not only maximizes the production of power, but it also helps the arrays find their orientation in space so that they can accurately point antennae at ground stations.

As part of the work on the (now postponed) Mars-2001 Surveyor Lander, NASA Glenn Research Center engineers developed a new Sun sensor that is far lighter and simpler than earlier designs. This sensor uses the technology of a linear photodiode array to find the position of the Sun in one axis. Two of these sensors, used together, can locate the *x* and *y* coordinates of the Sun relative to the spacecraft. These sensors have a mass of only 18 g each, nearly an order of magnitude lighter than earlier designs. (This mass does not include the electronic circuit to read the photodiode output, which is on the experiment microcontroller.) Near the center of the field of view, the Sun position can be found to 0.15°.

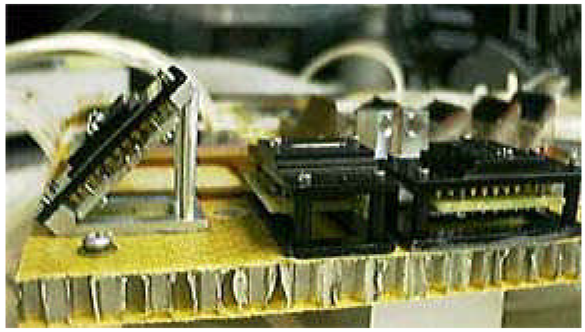


Lightweight Sun-position sensor.

The heart of each sensor is a cylindrical lens focusing light onto a 512-element linear photodiode array. An OD8 ND filter is used to reduce the intensity of the sunlight to avoid saturating the detectors. Although the primary purpose of these sensors is to allow solar cell measurements to be referenced to the true Sun position relative to the solar cells, they will also provide scientific data in the form of one-dimensional scans of the sunlight intensity across the sky. The sensor has been tested to operate at Mars daytime temperatures as low as 40° below zero, and it has passed flight certification tests such as vibration, thermal vacuum operation, and pyrotechnic shock. For the Mars experiment, two Sun sensors were used to locate the *x* (N-S) and *y* (E-W) position of the Sun near noon, and a third Sun sensor measured the height of the Sun at low elevations. This sensor for Sun position was also baselined as part of the Photovoltaic Engineering Testbed, where it will be used to accurately position a solar cell measurement platform to point at the Sun.

Sensors of this type can be used on many future satellites, including NASA space probes and communications and weather satellites. Similar sensors could be used for terrestrial

applications as well, for example, as a part of a control system to steer future solar arrays to face directly into the Sun.



Three Sun sensors mounted on the honeycomb Dust Accumulation and Removal Test (DART) experiment plate for the Mars-2001 Surveyor Lander. Left: Sun sensor tilted at 45° to measure the height of the Sun at low Sun angles. Center and right: two Sun sensors mounted to view the Sun overhead and measure its x and y position near zenith.

Find out more about Glenn's experiments on the Mars Surveyor Lander (http://powerweb.grc.nasa.gov/pvsee/experiments/2003.html).

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